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New records of pyrenocarpous lichenized fungi from Bulgaria

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ABSTRACT — Five pyrenocarpous species of lichenized fungi, *Acrocordia salweyi*, *Staurothele hymenogonia*, *Verrucaria praetermissa*, *V. viridula* and *Wahlenbergiella striatula*, are reported for the first time from Bulgaria. Detailed descriptions, illustrations, and comments are provided.

KEY WORDS — *Pyrenulales*, lichen taxonomy, *Verrucariales*

Introduction

Pyrenocarpous lichens comprise lichenized fungi with perithecioid ascomata. The taxa discussed here belong to the orders *Pyrenulales* and *Verrucariales*, characterized by having usually crustose, immersed or superficial thallus, variously colored and inhabit rocks, soil and bark.

Several lichenologists have taxonomically studied *Acrocordia* species in Bulgaria (e.g. Kazandzhiev 1906; Szatala 1929; Zhelezova 1963; Pišút 1969, 2001), while many specialists (see Mayrhofer et al. 2005) have surveyed *Verrucaria* and *Staurothele*, with more recent records provided by Vondrák (2006) and Krzewicka et al. (2007). Recently five additional species were found for the first time in Bulgaria.

Material & methods

This study is based on specimens collected by the authors during 2006, 2007, and 2011 and now housed in the Mycological Collection at the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia (SOMF). Determination of species follows Smith et al. (2009). Measurements of ascospores, conidia, and hymenial algal cells are given as follows: (min–) mean $\pm$ standard deviation (–max). Macrophotographs were made by means of a Windaus Labortechnik D-38678 dissecting microscope with Canon PowerShot A630 digital camera.

Taxonomic descriptions

Acrocordia salweyi (Leight. ex Nyl.) A.L. Sm., Monogr. Brit. Lich. 2: 315, 1911. PL. 1A

THALLUS immersed or superficial, greenish-grey to pale brown, thin. PERITHECIA 620–800 µm diam., one-quarter to half immersed. INVOLUCRELLUM tightly incurved around the exciple and continuous below. ASCOSPORES (19.7–) 22.4 ± 1.3 (–25.8) $\times$ (8.3–) 10.0 ± 0.7 (–11.3) µm, l/w ratio usually c. 2.2 (n = 25), colorless, ellipsoid, 1-septate. PYCNIDIA 0.2–0.3 mm diam. CONIDIA (3.0–) 3.5 ± 0.4 (–4.6) $\times$ (1.2–) 1.5 ± 0.1 (–2.0) µm, l/w ratio usually >2.2 (n = 25).

SPECIMEN EXAMINED — BULGARIA, Shoumen Plateau, Bukaka Nature Reserve, on sedimentary rocks in a shady habitat, 25 October 2007, D.Y. Stoykov (SOMF 27 992).

ECOLOGY & DISTRIBUTION — In shaded habitats on soft calcareous rocks. *Acrocordia salweyi* occurs in the sub-Atlantic region of the temperate zone over the sub-Mediterranean region to the Mediterranean area (Wirth 1995). Known from Europe (Santesson et al. 2004, Liška et al. 2008, Smith et al. 2009).

COMMENTS — Similar to *A. conoidea* (Fr.) Körb., but differing in the outwardly spreading base of the involucrellum and smaller ascospores (12–19 $\times$ 6–9 µm). Another species, *A. macrospora* A. Massal., has a laterally spreading involucrellum, but it never continues below the exciple.

Staurothele hymenogonia (Nyl.) Th. Fr., Bot. Not. 1865: 40, 1865.

PL. 1B

THALLUS endolithic, grey. PERITHECIA 270–420 µm diam., superficial, leaving small shallow pits in the rock, dusted with rock fragments. OSTIOLE plane or in a small depression. INVOLUCRELLUM present. HYMENIAL ALGAL CELLS (3.0–) 4.5 ± 0.9 (–6.6) $\times$ (2.3–) 2.8 ± 0.5 (–3.6) µm, l/w ratio usually >1.6 (n = 50). ASCI 8-spored. ASCOSPORES (19.1–) 22.4 ± 1.6 (–24.5) $\times$ (10.5–) 12.1 ± 0.9 (–13.8) µm, l/w ratio usually >1.8 (n = 25), colorless, ellipsoid, muriform.

SPECIMENS EXAMINED — BULGARIA, Forebalkan, Vratsa distr., near Stoyanovo village, on limestone rocks, 8 June 2006, D.Y. Stoykov (SOMF 27 986); Liutajik village, on calcareous rock, 7 July 2006, D.Y. Stoykov (SOMF 28 005); Stara Planina Mts (western), Lakatnik, along the path to the Temnata Doupka Cave, on pebbles, 6 September 2006, D.Y. Stoykov (SOMF 27 980); Strandzha Mts, Kovach locality near Zvezdets village, on rocks, 24 May 2007, D.Y. Stoykov (SOMF 27 995).

ECOLOGY & DISTRIBUTION — On limestone as well as porous granular substrata (calcareous sandstone, sandy dolomite, chalk pebbles) in lightly shaded to well-lit habitats. From the boreal pine belt southwards to the Mediterranean area (Wirth 1995). Reported from Asia and Europe (Grillo & Caniglia 2004, Santesson et al. 2004, Seaward et al. 2004, Spribille et al. 2006, Liška et al. 2008, Smith et al. 2009).

COMMENTS — *Staurothele hymenogonia* differs from other members of this genus by its smaller colorless spores.

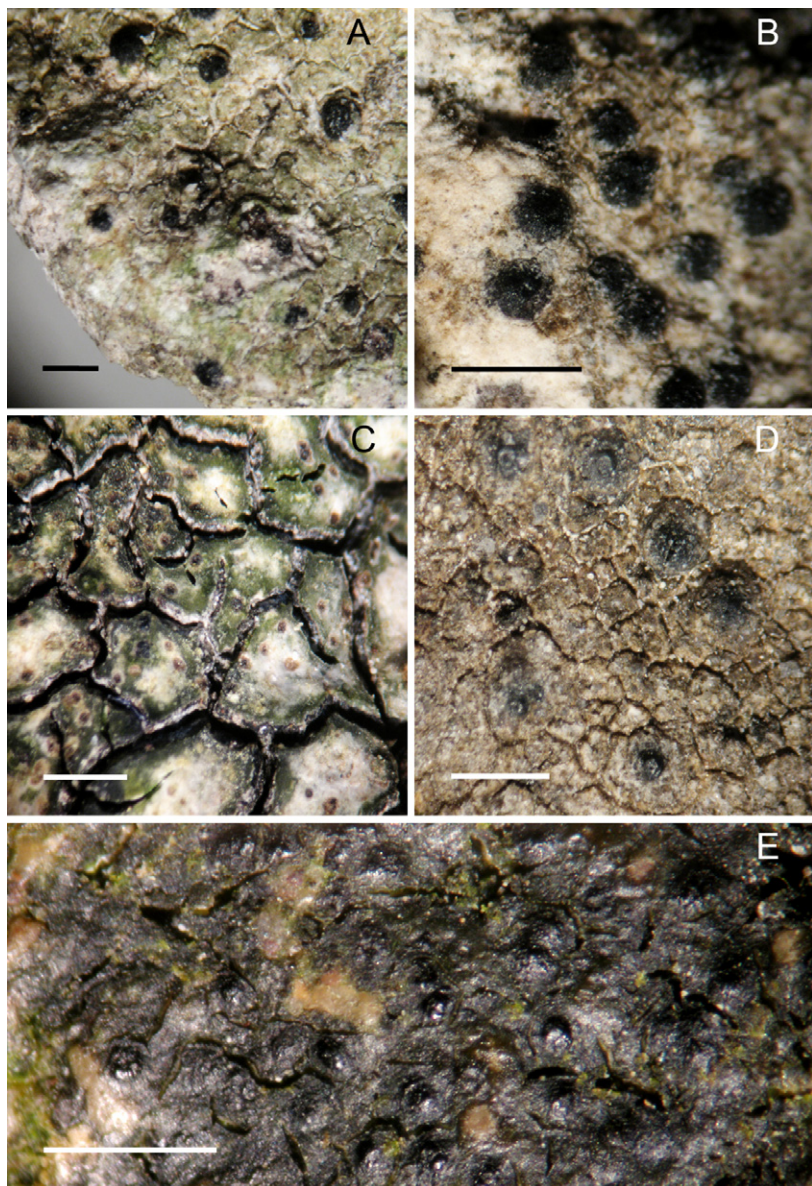


PLATE 1. A. *Acrocordia salweyi* (SOMF 27 992). B. *Staurothele hymenogonia* (SOMF 27 986).
C. *Verrucaria praetermissa* (SOMF 27 977). D. *Verrucaria viridula* (SOMF 27 991).
E. *Wahlenbergiella striatula* (SOMF 28 001). Scale bars = 1 mm.

Verrucaria praetermissa (Trevis.) Anzi, Comment. Soc. Crittog. Ital. 2(1): 24, 1864.

PL. 1C

THALLUS 40–260 µm thick, superficial, non-gelatinous, pale green or grey-brown; surface smooth, with numerous cracks when well developed. PROTHALLUS white. PERITHECIA immersed in thallus, at most forming very low projections, which are too ill-defined to measure; apex visible as a pink or brown dot. INVOLUCRELLUM conical, extending laterally and fusing with dark basal layer below. ASCI 60–85 × 13–25 µm, 8-spored, clavate. ASCOSPORES (15.5–)18.8 ± 1.8(–21.3) × (6.2–)8.0 ± 0.9(–10.0) µm, l/w ratio usually >2 (n = 25), colorless, ellipsoid, simple. CONIDIA (4.0–)5.0 ± 0.6(–6.2) × (0.9–)1.2 ± 0.1(–1.5) µm, l/w ratio usually >4 (n = 50), rod-shaped, some slightly curved.

SPECIMEN EXAMINED — BULGARIA, Shoumen Plateau, near the entrance of the Zandana Cave, on frequently inundated sedimentary rock in a shady habitat, 23 October 2007, D.Y. Stoykov (SOMF 27 977).

ECOLOGY & DISTRIBUTION — Amphibious in the splash water zone, rarely submerged for long periods. On hard and stable slightly acidic to basic siliceous or calcareous substrata near freshwater sources. Tolerating a wide range of illumination. From sea level to high mountain areas, very rarely reaching alpine sites (Thüs & Schultz 2009). Known from North and Central America, Asia, Australia, Europe, New Zealand (Aptroot & Seaward 1999, Smith et al. 2009).

COMMENTS — Similar to *Verrucaria hydrela* Ach., which usually develops thin subgelatinous crust with the basal involucrellum and exciple generally separated. There is no free space between the involucrellum and the exciple in *V. praetermissa*. Another close species, *V. elaeina* Borrer, has a thin epilithic thallus and prominent perithecia but lacks a black basal layer.

Verrucaria viridula (Schrad.) Ach., Method. Lich., Suppl.: 16, 1803.

PL. 1D

THALLUS immersed or superficial, pale brown to whitish, areolate, divided by cracks. PERITHECIA 200–500 µm diam., half to almost completely immersed in thallus, appearing as convex to conical-hemispherical projections, with basal part immersed in the substratum. INVOLUCRELLUM poorly developed, seen only in the upper half of the exciple. ASCOSPORES (27.9–)32.6 ± 2.9(–38.5) × (15.3–)19.1 ± 1.5(–22.1) µm, l/w ratio usually >1.7 (n = 25), ellipsoid to broadly ellipsoid, sometimes with perispore. PYCNIDIA appearing as dark dots. CONIDIA (8.5–)10.0 ± 1.2(–13.2) × (0.9–)1.3 ± 0.2(–1.8) µm, l/w ratio usually >7.5 (n = 25), straight to slightly curved.

SPECIMEN EXAMINED — BULGARIA, Mt Vitosha, above Douhlata Cave, on calcareous rock, 22 May 2011, V.V. Shivarov (SOMF 27 991).

ECOLOGY & DISTRIBUTION — In foothill and submontane sites. On calcareous rocks (including limestone). Widely distributed in Europe (from temperate regions to the Mediterranean area), it is also known from Africa, North and

Central America, Asia, Australia, and Macaronesia (Wirth 1995, Santesson et al. 2004, Spribille et al. 2006, Liška et al. 2008, Smith et al. 2009).

COMMENTS — *Verrucaria viridula* is variable but distinguished by its large ascospores and the apex of the perithecium, which often forms a beak. The thallus is typically superficial, cracked, and occasionally scarcely apparent. *Verrucaria hochstetteri* Fr. has similar-sized spores but differs by its endolithic thallus and absence of involucrellum.

Wahlenbergiella striatula (Wahlenb.) Gueidan & Thüs, Taxon 58: 199, 2009. PL. 1E

THALLUS superficial, subgelatinous, green to dark dull green, translucent when wet, very thin or up to 250 µm, cortex absent. PERITHECIA 180–350 µm diam., forming prominent conical projections, with often irregular shape, usually divided by large irregular ostiole. EXCIPLE dark brown, but paler at base. INVOLUCRELLUM thick, appressed to exciple and broadened at base. HYMENIAL GEL I+ blue, then light purple. ASCOPORES $(6.2-8.7 \pm 1.1(-11.0) \times (4.2-6.0 \pm 0.8(-7.1) \mu\text{m}$, l/w ratio usually c. 1.4 ($n = 25$), ellipsoid. PYCNIDIA not seen.

SPECIMEN EXAMINED — BULGARIA, Black Sea coast, Sinemorec village, near the North Beach, on rocks periodically flooded by water, 13 September 2011, V.V. Shivarov (SOMF 28 001).

ECOLOGY & DISTRIBUTION — Maritime species in mid-littoral zone on rocky seashores. Reported from America (North), Australia, Europe, and New Zealand (Santesson et al. 2004, Orange 2008).

COMMENTS — *Wahlenbergiella* has recently been separated from *Verrucaria* to accommodate the two marine species, *V. mucosa* Wahlenb. and *V. striatula* Wahlenb. (Gueidan et al. 2009). *Verrucaria halizoa* Leight., the only close species recorded from the Bulgarian Black Sea coast (Krzewicka et al. 2007), differs in its thin olive-green thallus, different perithecial shape, and oblong-ellipsoid ascospores with l/w ratio up to 3.5.

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